# Two-pulse Rapid Remote Surface Contamination Measurement

## **Sandia National Laboratories**

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## Problem

There is a need to remotely (3-m-standoff) sense low-volatility chemical contaminants on surfaces

#### **Applications**

- Low-volatility chemical agent (LVA, e.g., VX) detection during: - Decontamination activities
- Battlefield sensing of "denied" territory ■ Radiological material ("dirty" bomb) detection
- **■** Biological agent residue detection

#### Potential customers and areas:

- DTRA Chemical, biological, nuclear
- DHS Chemical, biological
- DNDO Nuclear

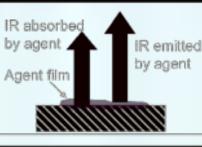


Vehicle decontamination

We are focusing on LVA detection

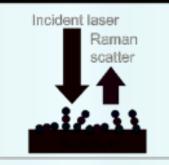
Existing methods are limited in performance for **CWA** detection





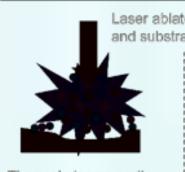
Surface spectrum can mask agent spectrum Signal can fade with low thermal contrast

#### Raman spectroscopy



- Under development for LVA detection by DOD/DHS
- · Raman is generally a lowsensitivity method

#### \_aser-induced breakdown spectroscopy



distinct atomic spectra

- Agent indicated by carbon
- and phosphorous presence Signal is indistinct and can be masked by emission from surface atoms

# Approach

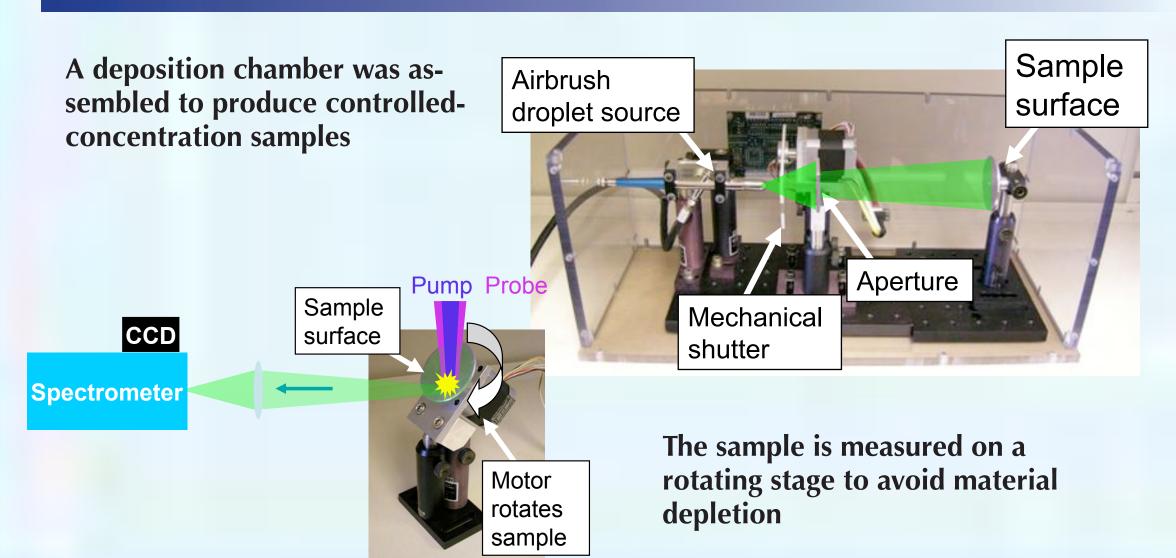
We are developing a pulse-probe method for LVA detection:

(2) Excitation Probe (~246 nm) (1) Fragmentation (3) LIF emission Pulse (266 nm) (250-255 nm) releases PO Method has been demonstrated in the vapor phase – we are extending it to measurement of Surface

#### Example: Detection of VX

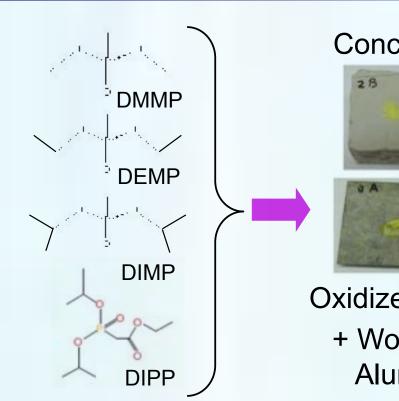
## Results

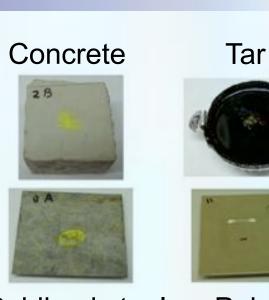
surface agents



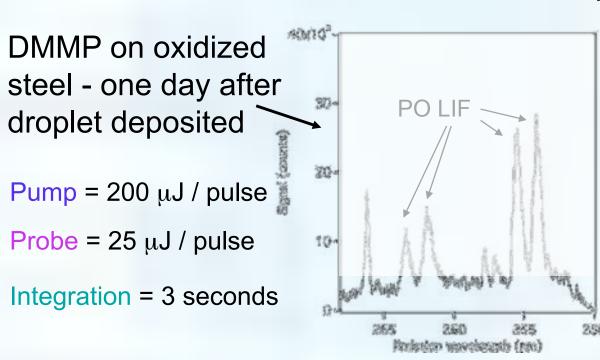
## Results (cont.)

**Detection of four** simulants has been demonstrated\* on 7 substrates



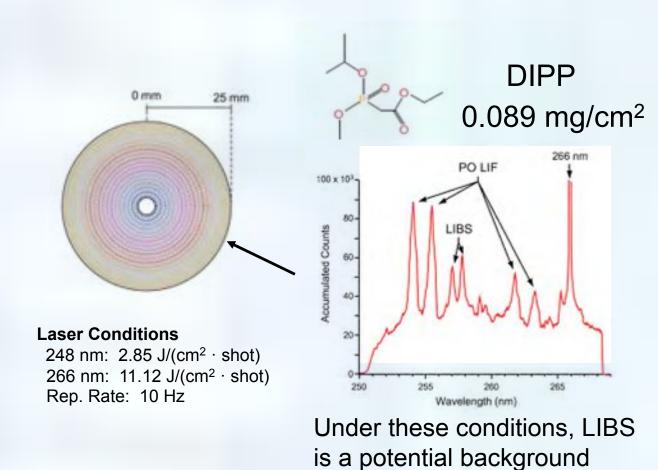


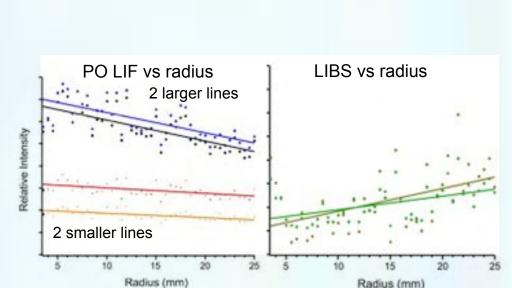
Oxidized steel Paint + Wood, Cardboard, Aluminum



\*Not all quantitatively

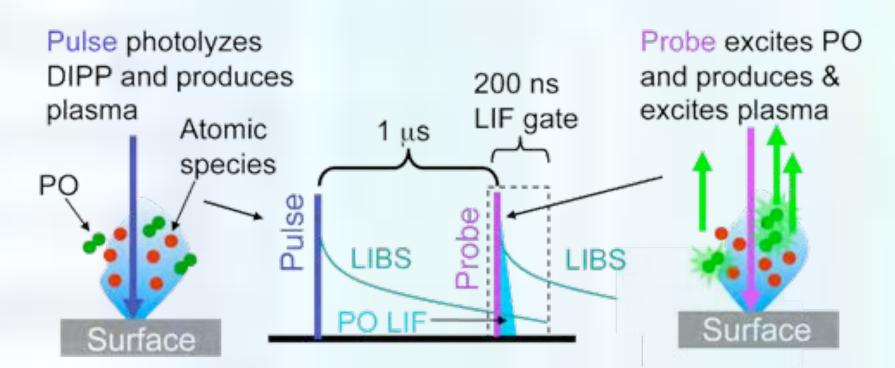
## Quantitative detection of DIPP on aluminum



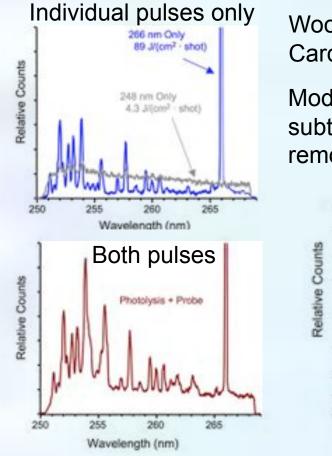


 Radial measurement shows uniformity of deposit Also shows anti-correlation between LIF and LIBS

## Mitigation of LIBS is a priority



#### In some cases, LIBS can be modulated and subtracted



Wood + 0.098 mg/cm<sup>2</sup> DIPP; Cardboard produced similar results Modulation of probe pulse and subtraction of on/off signals allows removal of LIBS, in this case

Difference Wavelength (nm)

# Significance

- Pulse-probe method, previously demonstrated in vapor phase, is also applicable to surface measurement
- Method releases and detects PO from multiple organophosphate species on various surface materials A quantitative evaluation is underway to determine the sensitivity of the measurement
- Optical emission caused by surface LIBS is an interfering signal ■ FY10 work will focus on minimizing or eliminating the LIBS background



